

any subsequent reference to a continuing colony, and search in 1945 for such a colony, have failed to locate anything more.

The collection reported for St. Andrews, New Brunswick, July, 1944, by Mr. Weatherby, was not the first from this station. Specimens secured by J. Adams, September 1, 1936, and by H. Groh, July 31, 1936, are in the Divisional Herbarium, but have not been reported.—HERBERT GROH, Central Experimental Farm, Ottawa.

## ON THE DESCRIPTIVE METHOD OF LINNAEUS

H. K. SVENSON

(Continued from page 302)

How well Clayton's English notes were translated into Latin by Gronovius, I cannot say. But the English common names did not always fare well, as may be seen by his treatment of the skunk cabbage (p. 186): "CALLA aquatilis odore alii vehementer praedita, radice repente, vulgo **Pole Cadweed**. *Clayt. n. 17.*" Clayton undoubtedly had written, at least approximately, "Calla, with creeping root, growing in wet places, with a strong odor of onions, commonly called Polecat Weed." A description was given by Gronovius, but no specific name. The latter was supplied by Colden, and was copied by Linnaeus in *Species Plantarum* (p. 967) as: "DRACONTIUM foliis subrotundis. *Cold. noveb. 214.*" On the other hand, the jack-in-the-pulpit received a specific name from Gronovius (p. 186): ARUM *caulescens foliis ternatis*, and his italics show that it was a new name. This was based on Clayton's no. 539, which bore the descriptive note: "Arisarum triphyllum altissimum, spatha & spadice omnino albovirescentibus". Gronovius' specific name was taken up, practically intact, by Linnaeus in *Species Plantarum*, p. 965.<sup>43</sup>

Of the Clayton specimens, Linnaeus saw only the first installment except for duplicates which Gronovius later sent him, or of specimens in the collections of other persons.<sup>44</sup> The assistance of

<sup>43</sup> The Brazilian collection to which Linnaeus refers under *Arisaema triphyllum* came from Canada, and was part of the Burser Herbarium (cf. Juel, H. O. *Symbolae Bot. Upsal.* II, pt. 1: 5. 1936).

<sup>44</sup> Linnaeus to Bergius (Hulth no. 519), July 2, 1753: "At Beck's I saw a *Ribes* from America, recently received from Gronovius, *pediculis dichotomis*." Clayton also sent some living plants, for Beck (Hulth Letter no. 626) saw *Hamamelis* in London, which Clayton had sent to Catesby.

Linnaeus was chiefly in helping Gronovius arrange the new flora according to the Linnaean method, and in describing some new genera. The situation has in general been so misunderstood that I am quoting (in translation) from the preface of *Flora Virginica* (1739), which was addressed to Clayton:

"I have therefore not hesitated to undertake this work, leaning upon the assistance of our friend, and to examine your gift of specimens (as many as had been up to that time received) with keen-eyed Linnaeus, and to search out the characters of the rare plants which had not been assigned to their genera.<sup>45</sup> I wish that I could recall that learned man [Linnaeus] to examine the remainder of the specimens which you sent me in this and the previous year. After his departure I carried on alone, to the best of my ability, the work of writing up the characters of rare plants; and I earnestly ask you to examine these characters anew in the living plants and to correct any errors which I may have committed.

For certain plants I have given the specific names which are in *Hortus Cliffortianus* and *Flora Laponica*; for the remainder, which had no obvious names, I have myself adapted specific names according to the method prescribed by Linnaeus. For some plants I have omitted names, not sufficiently trusting my own observations; therefore I propose that you examine them for insertion in the second edition of the *Flora Virginica* which I am preparing.

For each plant I have added as a rule only a single synonym, from which others may be easily found; except for a few plants where synonyms are scattered among various authors and have not hitherto been assembled. Furthermore it will be well to place an asterisk before the names of plants listed in the catalogue of which specimens have not reached me."<sup>46</sup>

As I have pointed out (*RHODORA* 41: 521-524. 1939), *Quercus rubra* of Linnaeus included all the American species with lobed and bristle-tipped leaves, and of these the northern red oak was first clearly differentiated by Du Roi in 1772. Much the same is true of *Quercus Prinus* L. This species first appears with a spe-

<sup>45</sup> Melothria, Xyris, Houstonia, Cephalanthus, Claytonia, Pontederia, Prinos, Medeola, Rhexia, Clethra, Hydrangea, Penthorum, Trichostema, Schwalbea, Diodia, Obularia, Chrysogonum, Nyssa.

<sup>46</sup> Cf. also *Amoenitates Academicae*. Vol. III. n. 31. p. 5. 1751 (L. J. Chenon, sub *Praesidii Doct. Caroli Linnaei*): "Gronovius, in *Flora Virginica* (1739 & 1743), enumerated more plants of North America than all others before him; all of which John Clayton, who lived in Virginia, had collected. The illustrious Gronovius examined them, added synonyms, referred them to genera, and distinguished them by specific differentiae." And Jacob Biuur, *Amoen. Acad.* 3: 388, 389. 1753. "Species Plantarum, which comprises all the species which he (Linnaeus) has treated in his previous works, or later examined, or any that have been collected or described by his associates: as well as those which have been sent to him from all parts of the world, by *Gmelin* from Siberia, by *Sauvage* from Mt. Pessulano, by *Loefling* from Spain, by *Kalm* from Canada, etc. Gronovius has written *Flora Virginica* (1739) in which he enumerates many plants, which Clayton had diligently collected and sent; these he examined, referred them to genera, determined them with differentiae and added synonyms; and in this work no botanist has gone further."

cific name according to the Linnaean method in *Hortus Cliffortianus* p. 448 (1737):

*Quercus* foliis obverse ovatis utrinque acuminatis serratis;  
denticulis rotundatis uniformibus.

*Quercus castaneae* foliis, procera arbor virginiana. Pluk.  
alm. 309, t. 54, f. 3. Raj. hist. 1916. Catesb. ornith.  
18. t. 18.

*Crescit* in Virginia & Carolina.

This specific name remained unchanged in Gronovius' *Flora Virginica*, and to it was assigned Clayton's specimen. The trees grown in Clifford's garden presumably came from England, the source of most of the American plants then grown on the Continent. Clifford's tree had leaves with "denticulis rotundatis uniformibus" as did the Plukenet figure, and through Du Roi (1772) and Marshall (1775) this northern tree has come down to us as "*Quercus Prinus*" even in Sargent's *Silva of North America* (1895). Here in a note (vol. 8, p. 53) was the first inkling of the change that was to be made later: "The early description of the Chestnut Oak might apply as well to the Swamp Chestnut Oak (*Quercus Michauxii*) as to this species which does not grow near the coast of Virginia, where, however, the Swamp Chestnut Oak is common, and may have been the first of the Chestnut Oaks noticed by the Europeans". To this may be replied that Banister, who collected much of the early material described by Plukenet, did not lose his life by falling off a mountain on the coastal plain. Many other plants were collected by Banister in the Virginia mountains<sup>47</sup>, where *Quercus Prinus* (*Q. montana* Willd.) is abundant. Michaux (*Chênes Am.* 1801) made *Q. Prinus* into five subdivisions in a peculiar trinomial manner. Of these *Q. Prinus palustris* was based on Clayton no. 77, and *Q. Prinus monticola* on Marshall's species no. 16. This was renamed *Q. montana* by Willdenow in 1805.

In the Linnaean Herbarium in London, which I examined in 1937, there are three specimens of *Quercus Prinus*, all of the

<sup>47</sup> Cf. Ray, *Historia Plantarum*, Vol. III lib. xxv, p. 6. 1704, "Nux Juglans Virginiana fructu minore oblongo. Ex superioribus montosis fluvii inundationibus aliquando defertur, & in rupibus ad praecipitia aut catarractas invenitur." Professor Fernald has written "There is every reason in the world why Linnaeus could have had *Quercus Prinus (montana)* and *Q. rubra (borealis, var. maxima)* from Clayton. They both abound on the lower James River (See *Rhodora*, xl. 182 & 412). Several later stations were found farther down the James." Changes in application of the names were undoubtedly due to Ashe.

northern tree now frequently called *Q. montana* Willd. Two of these specimens are from Kalm, one of them with staminate flowers; both are labeled "Prinus" by Linnaeus under the number "7", according to the enumeration of species in *Species Plantarum*, and the sheets also bear the number "15". A third sheet (no. 34) bears the label in Linnaeus' hand: "Quercus foliis obverse ovatis, utrinque acuminatis serratis, denticulis rotundatis uniformibus. Hort. Cliff. 448". This specimen, with staminate flowers, has the characteristic shallow crenate toothing of the northern tree, leaves densely stellate-pubescent below, and the winter buds silky tomentose. Nothing is further indicated as to its source. A fourth sheet (no. 20) from Kalm is merely marked "7" by Linnaeus, and was placed under "8" (*Q. nigra*) by J. E. Smith; it is *Q. heterophylla*.

It is advantageous here to discuss other American oaks in the Linnaean herbarium, since they tend to show that the Linnaean species was not based on type specimens, but was rather the subdivision of a genus comprising all specimens, illustrations and descriptions, falling within the differential limits of the specific phrase name.

*Q. nigra*: sheet 18, "8 nigra K" and sheet 19 "8K" (i. e., both from Kalm). On the latter the number "9" has been written above, and there is the notation "triloba n. 47 det. Smith".

*Q. rubra*: sheet 21, "K" (*discolor* det. Smith). The lower surface is densely stellate-pubescent. This is *Q. falcata* Michx., or a deeply incised form of *Q. velutina*. Sheet 22: "9" ("discolor H. Kew" det. Smith). The lower surface is densely tomentose-stellate and the upper surface a bit scurfy-stellate. It bears on the reverse side in Linnaeus' hand: "Quercus foliorum sinibus obtusis, angulis lanceolatis seta terminatis integerrimis (vix divisus deleatus et legatus subtus tomentosis)"; i. e., from the Gronovian specific name of *Quercus rubra* the phrase "vix divisus" [somewhat divided] was to be deleted and "subtus tomentosis" inserted. It is probable that this was a modification of the specific name intended for future publication. Sheet 23: "rubra K", a young specimen with staminate flowers from Kalm, determined as *Q. palustris* by Smith, and is that. Sheet 24: "9 K" a mixture of the northern red oak and *Q. palustris* (det. "rubra & palustris" by Smith). Sheet 25: "K" ("*ilicifolia* Willd. no. 59" det. Smith).

*Q. alba*: sheet 26 "10 K alba". A specimen from Kalm with elongate mature leaves glabrous below, and with very narrow lobes. Sheet 27: "476 Quercus alba". A very young specimen of *Q. stellata* from Gronovius with staminate flowers, lower leaf-surface hairy matted, and the upper with stellate hairs on the veins toward the margin of the leaf. Sheets 26 and 27 are pinned together. Sheet 35: "K"; a single leaf (15 x 12 cm.) of *Q. stellata*.

From the foregoing account of literature and herbarium material, it should be obvious that most Linnaean species consist of two or more species of general present-day usage. Only occasionally, as in *Viburnum dentatum*<sup>48</sup>, is it based unequivocally upon a single collection. If the Linnaean *Quercus rubra* is to be rejected because it is based on two or more species of our present interpretation, then the names *Quercus alba*, *Q. nigra*, and *Q. Prinus* should also be discarded, along with most other Linnaean binomials.

With these preliminary remarks we come to the crucial point in the interpretation of Linnaean species: the relative value of specimens, figures, descriptions and synonyms. It is quite evident that Linnaeus considered the species as an entity which included all these elements. All entities were part of the species and "by knowing any synonym one would know the species". This is true also of herbarium specimens, whether or not they represent the species as we now understand it. *Species Plantarum* was written from a practical point of view, and the fact that Linnaean species were more inclusive, in general, than species of today, does not modify the original status of the Linnaean species.

Thus the statement of Wheeler (Contrib. Gray Herb. n. s. no. 127: 76. 1939), in discussing the identification of *Euphorbia maculata*, that "the identity of the plate is of secondary importance since the specimen in Linnaeus' herbarium takes precedence over cited figures" controverts all Linnaean philosophy, and it is only natural that Wheeler should therefore have found the Linnaean method only chaos. The Plukenet plate has come down through botanical usage and history as the recognized representation of *Euphorbia maculata*. It was based on plants

<sup>48</sup> Cf. RHODORA 42: 1. 1940.

growing in Walker's garden at London as early as 1660 (Plukenet t. 65, fig. 8. 1691). *E. maculata*, in the sense of Asa Gray, has been well known as a European weed (cf. Hegi, Ill. Fl. Mittel-Eur. f. 1757 (1911)). Although no scale was given in Plukenet's plate, I believe it to be the generally recognized *E. maculata* (*E. supina* Raf.) because of the following characteristics: 1) it has the reduced axillary shoots very characteristic of *E. maculata*, but rarely seen in *E. nutans*; 2) the leaves are slightly, but definitely, petioled, which is a characteristic of *E. maculata* and not *E. nutans*; 3) the leaves of *E. maculata* are as frequently 3-veined as not, as a casual inspection of herbarium specimens will show. See PL. 990.

There seems to be no reason for Wheeler's change of the traditional usage of the Linnaean *Euphorbia maculata*.

There is nothing in the description, in my estimation, which would discriminate between *E. maculata* and *E. nutans*. It applies equally well to either one. Linnaeus, in the Second Mantissa 382. 1771, merely said: "*Euphorbia maculata* similis *E. hypericifolia*", and nothing more. The treatment in *Species Plantarum* (p. 455) is as follows:

21. EUPHORBIA dichotoma, foliis serratis oblongis pilosis, floribus axillaribus solitariis, ramis patulis.  
Tithymalus s. Chamaesyce altera virginiana, foliis crenatis & macula fusca eleganter notatis. *Pluk. alm.* 372. t. 65. f. 8.  
*Habitat in America septentrionali.*  
Caules dichotomi: Ramis alternis, patentibus, supra purpurascentibus. Folia ovali-oblonga, trinervia, subpilosa, serrata, altero latere maxima parte integerrima, tenera adhuc planta notata macula fusca. Flores axillares, solitarii, parvi, calyce rufo.

It will be noted that this Linnaean treatment consists of 1) a new specific name; 2) a synonym; 3) habitat; and 4) a description. Most of the other species of *Euphorbia* treated in the first edition of *Species Plantarum* had been described in the *Amoenitates*—*Euphorbia maculata* is evidently one of those plants, mentioned in the preface of *Species Plantarum*, for which a description "sine ambagibus" was added.

Since *Species Plantarum* was a compendium based partly on illustrations, there are many instances where pictured material of great similarity in appearance, but representing as we now

understand it, distinct species, was included under the same specific name. Such, for example, were the American *Asclepias syriaca*, based partly on illustrations by Cornut and Clusius<sup>49</sup>; and *Trillium erectum*, based partly on the purple-flowered plant of Cornut's plate (which was said by Cornut to have a white variation), and partly on the once white-flowered specimen of *Trillium grandiflorum* in Burser's herbarium.

Progress of the art of illustration is taken up amusingly, and at the same time regretfully, by Linnaeus in his message to the Royal Academy (Jan. 3, 1765; Fries, Letter no. 367):

"In order that I may further follow the progress of my natural sciences, I observe how the first workers after the *Palingesia literarum* tried to understand the objects of creation, and to illustrate them by descriptions and figures.

"Descriptions were then wrapped up in long and lofty orations; now they have just so many words as are necessary, and without a whipped-cream covering—that is, they are characteristic descriptions which exclude common structures. One no longer says of animals that the head is placed in front of the body, or the eyes in the head, or that a bird has two wings and two feet; or that, in the case of a plant, that the root is dark, the leaves green, the flower beautiful, and that the fruit comes after the flower—one states only the characteristic things.

"Figures provide a similar situation. If I compare the first figures, for example those of Cuba in *Hortus Sanitatis* with Ehret's in *Hortus Cliffortianus*, they appear like ghosts among angels. Figures of the 15th century needed a superscript in order to be understood; they painted a rabbit and said it was a bear. They made figures according to the stories of others, without having seen the object.

"In the beginning of the 16th century the figures were poor, but toward the end of the century they become tolerable, especially after the good masters began carving in boxwood.

"With the beginning of the 17th century, when it was seen that subtle lines could not be cut well in wood, some began to employ copper; at first it went rather slowly and the plates became smudges. But before the century's close appeared Dodart's beautiful figures from the French Academy of Science, not to mention others.

"Even at the beginning of this century, in spite of the fact that the figures had become reasonable enough, one had to get together a whole lot

<sup>49</sup> This plant, the widespread *Calotropis procera* Ait., was brought to Vienna from Jericho by Weixius, and illustrated by Clusius in 1601. This illustration was not unlike Cornut's plant from Canada, and Linnaeus took Cornut's word for their identity. Cornut, *Pl. Canad.* 1635, p. 89 says: "I here offer a double differentia for *Apocynum*: maius & minus. [These were respectively *Apocynum maius Syriacum* and *A. minus Canadense*, known now as *Asclepias syriaca* and *A. incarnata*]. *Maius* I believe to be the same as Clusius has described under the name *Apocynum Syriaci*. But since a description is lacking and the plant is mutilated (for there is nothing of the root and of its duration, and of the flowers and juice little is known). Furthermore, the learned man states that he has seen the plant only in small dried fragments I have added what seems to be lacking in description."

of synonyms each time a plant or animal was to be determined. One had to get a sufficient library and set up all the citations until naturalists began to paint their objects in lifelike colors, so that one could not possibly be mistaken. I am not speaking of the old illuminated figures which made all leaves the same shade of green, or all yellow flowers the same kind of yellow: but I refer to the Surinam insects of Merian, Seba's paintings, Frischen's birds, Catesby's fishes, Ehret's plants, Roesel's insects, Edward's birds, Regenfus's snails, in which the objects stand as though living, as well as the best portrait painter delineates the human face. Among all these, Roesel is best in the insects, Regenfus in shells, Ehret in plants—all of which are so beautiful that the most stupid Hottentot could stand in admiration and affection for the master's work.

“If I ask, furthermore, what has brought this kind of literature to such a height, I will reply that patronage has been entirely responsible. Wealthy Englishmen supported Catesby's voyage to America, and paid well for his pictures. Roesel was supported by a baron. Ehret's plates brought a guinea apiece, as fast as he could produce them. His Majesty of Denmark's generosity brought us Regenfus's shells. Edward's patron can be read about in his preface. The English boast of Edward, the Germans of their Roesel, the Danes of their Regenfus, and with much reason.

“Our librarians have obtained a new point of view from them; even potentates must stand at the opening of these books, and be drawn into support of the natural sciences. I have tried [unsuccessfully] to get Clerck's figures published . . . This has placed me in wonderment that I, in the 27 years since I returned from my foreign travels, never could command a single good figure. With this help, I, who have had the opportunity of seeing more of our rare plants and animals than anyone else, would surely have brought out some observations quarterly.”

---

It may now be of some interest to trace the progress, or rather the change, of the Linnaean conceptions as they are enunciated in the introductions to succeeding issues of Linnaean works. Many of these were by authors who had lost contact with the Linnaean method, and whose publications merely retained the Linnaean trade-mark, so to speak.

Linnaeus' *Systema Naturae* appeared as a very small publication in 1735. It ran through twelve editions, the last (in 1766) with notes by Fabricius. A number of these editions represented merely translations into other languages, and the eleventh edition is non-existent. The most important were the fourth (by B. Jussieu in 1744), the ninth by Gronovius in 1756, and the tenth in 1758.

Beginning with the thirteenth (ed. Murray) in 1774, the botanical part was separated out as the *Systema Vegetabilia*, based upon the twelfth edition (1766–1788) of the *Systema*



*Naturae*. Another edition by Murray appeared in 1784, and this was translated into Italian (as the fourteenth edition) and was also issued with very slight changes by Persoon in 1797. In the meantime Gmelin's edition (which he called the thirteenth) had appeared in 1791, and caught up the names in Walter's *Flora Caroliniana* (1788). The remarkably fine edition (also inscribed as the fifteenth) by Roemer & Schultes required the span of years from 1817 to 1830, and during this interval came the final edition (the sixteenth) by Sprengel in 1825.

In 1817 Roemer & Schultes began their monumental edition of the *Systema Naturae*, and the preface of this work is an extended account of the difficulties which had arisen in the field of systematic botany. It is as fresh and timely today. As they state, Persoon's unsatisfactory edition of the *Systema* had appeared twenty years before (1797). The early death of Willdenow had left his edition (fourth) of *Species Plantarum* unfinished, and the same was true of Vahl and his *Enumeratio Plantarum*. Lamarck's *Encyclopedia*, in process of completion by Poiret, was too large and expensive for ordinary use. The number of species and synonyms since the time of Linnaeus had increased out of all bounds due to the opening up of Australia and America, and the number of herbarium specimens now preserved in various institutions was far beyond the power of any single human being to correlate.

"What (p. vii) was allowed the father of the science is not forever permitted his successors. And for these a new edition either of *Species Plantarum* or of the *Systema Vegetabilia* is necessary for determination of plants: with synonyms not only for species, but for the synonyms scattered about among genera, orders and even classes. From these, new miseries have arisen for even the best botanists of our time. Scarcely half of the plants have been seen that have been collected and described in our time—a burden for many camels—preserved in the museums of London, Paris, Madrid, etc.: so that a man's life would not suffice in comparing and describing either those known or those in herbarium collections . . . For not only are many specimens deceptive, often badly dried or poor in other ways, but even those plants that are living; so that it not rarely happens that excellent botanists have published this or that new species, but later acknowledged it to be only a variety of a species already known. We have omitted genera, since Nature herself has not produced genera; perhaps not even species, you may readily say, if you consider those royal battles of botanists as to what should be considered a species. These arguments could easily be solved, if you would consider as *forms*<sup>50</sup> what they often call *species*—but forms of some importance and

<sup>50</sup> This seems to be the first use of the word "form" in a classification sense, but Roemer & Schultes give no further definition.

easy distinction . . . And what advantage lies in a battle of words, when it is sufficient to know that a plant may have leaves now ovate, or again lanceolate?

“To the diagnoses expressed in an oracular style, as was customarily done in previous editions of *Systema Vegetabilia*, it seems best for us not to acquiesce. We are persuaded that but few species can be distinguished easily and definitely by these diagnoses alone. We have therefore added short descriptions to the diagnosis, by which the plant can be determined more easily and correctly.

“We (p. ix) have diligently added copious synonyms. The way to enter the sanctuary of truth is to be sceptical in judgment (which we express by the sign ‘?’) . . . If we fail in synonymy there is some excuse in the diverse names published at about the same time by various authors, and the diverse plants published under a single name, and the heteronyms which refer to the same plant under different names. Of synonyms those only are of value by which the plant can be readily and securely known to all botanists. There is nothing in a synonym or a homonym or a heteronym, when a plant—either per se or by fallacious and difficult description or rarity—is dubious, or has been based by its authors on an imperfect figure or description: there you will not rarely find ten or more synonyms. . . . If, therefore, you perhaps find the same plant written up under two or even three names in our edition, you should not wonder or be too critical before you have patiently looked through the botanical works of others . . . Who does not detest the enumeration under one name of different plants which have not been seen, or the inclusion of two or three diverse species? By monographs the core of botany will ultimately be reached, so that further doubt may not proceed from the doubtful, and that the abyss will not invoke a greater abyss. We have not dared to change the diagnosis or definition of plants we have not seen.

“All (p. xiii), who may propose new species, are advised to be thoughtful of the future, and to place the new species in its systematic place, indicating its place between species already known, and to which it is most clearly related. We have placed new species at the end of the genus, rather than to interpolate them ourselves.”

#### THE TRIVIAL NAME

Binomials had appeared sporadically in the publications of Bauhin, Cornut, and others, but not until their use by Linnaeus did they become adjuncts to specific names. The idea itself was one of almost childish simplicity, and the strength of the trivial names lay in the specific phrase names which they represented. It is probable that Linnaean trivial names had their inception in pharmacological terms such as *Sarsaparilla*, *China*, *Tacamahacca*, *Tragacantha*, etc.; it is at least of interest to note that the ordinary Latin adjectives which are often employed as trivial names are not listed in the index to trivial names in *Species Plantarum*, and we may infer therefore that the substantives were considered

as of more importance. As has been pointed out by Sherff (quoting L. H. Bailey; Bull. Torrey Bot. Club **67**: 374. 1940) it would be as logical to have monomials as binomials. This had already been done to some extent by Ehrhart in 1790 (cf. RHODORA **31**: 171. 1929) and such monomials as *Trichophyllum* were taken up by some American botanists and combined as though they were legitimate generic names. Ehrhart was not the only one to advocate the use of monomials, even in limited usage.<sup>51</sup>

Nor was *Species Plantarum* the first place where trivial names were used by Linnaeus. As he says in *Philosophia Botanica* 257: "*Nomina trivialia* may be admitted after a fashion, as I have used them in Pan Suecica; they consist of a single word freely selected from any source."<sup>52</sup> A list of over 800 plants in Pan Suecica bears such names, the method as mentioned by Hasselgren in Amoen. Acad. **2**: 213. 1749 being as follows: "I have arranged the plants of Flora Suecica according to their catalogue numbers; and so that I could study them in brevity, I found it advantageous to add to the generic name a short and insufficient epithet, which is made clear by the Flora itself". An even earlier indication is seen in the italicized second word of the specific name, as in the account of "Radix Senega" issued by Kiernander in the Amoenitates in April, 1749. This paper is perhaps the real genesis of the Linnaean binomial, since in nine

<sup>51</sup> Cf. A. P. DeCandolle, Théorie . . . Bot. 224. 1813: "It is true that the Linnaean method facilitated the study of names; it is also true that it brought to students the possibility of knowing the name of a plant without knowing its character, and thus to place the word for the thing itself. It was without doubt, in accordance with this idea, that Haller rejected specific [i. e., "trivial"] names, but gave great emphasis to descriptive phrases . . . A second inconvenience of the Linnaean nomenclature was to admit the name of the genus as a basis for the name of the species: in effect, genera are very arbitrary, more variable than species; and so, any plant one meets has received four or five names, solely because different botanists have thought that it should be placed in four or five different genera. Therefore, some naturalists, among them Richer de Belleval, Renaulme and Buffon, have thought that it might be more convenient to give each species a single name, so that nomenclature might be independent of classification and not participate in its variations. But this method has been renounced, partly because of the large number of names, partly because there is no aid to memory, and finally because nomenclature itself is a guide to related species."

<sup>52</sup> A. DeCandolle, Lois de la Nomenclature Botanique. 1867. Footnote, p. 7: "What appears to us today to be the most fortunate and the most important of Linnaeus' ideas, seemed to him merely an accessory; for in the editions of his *Philosophia*, all published after 1745, he discourses at length on the phrases (*nomina specifica*) and merely mentions what we now call the specific names . . . In his dissertation of June 1753, *Incrementa botanices*, in which he considered himself as a reformer in science . . . he did not remark on the employment of binomial nomenclature."

out of ten of the plants (in addition to *Polygala Senega*) which were reputed remedies for rattlesnake bite, the italicized word is taken over directly into *Species Plantarum*. One of these plants was an unidentified plant of Plukenet; the others were *Aristolochia Serpentaria*, *Actaea racemosa*, *Prenanthes alba*, *Veratrum luteum*, *Osmunda virginiana*, *Sanicula canadensis*, *Uvularia perfoliata*, *Aletris farinosa*, *Cunila mariana*.

In some other accounts in the *Amoenitates*, the trivial name, instead of being italicized, was enclosed in parentheses. When it came to writing *Species Plantarum*, Linnaeus placed such names "in the margin", as he says in the introduction to *Species Plantarum*. With an outlook to the future, he continued with the important advice which has been but little heeded, or not at all, "Caveant autem quam sanctissime omnes sani Botanici, umquam proponere nomen triviale sine sufficienti differentia specifica, ne ruat in pristinam barbariem scientia." (All botanists must beware of proposing any trivial name without sufficient differentia specifica, lest the science fall into its original barbarity.) "I have placed the trivial name in the margin so that we may find any plant whatever encompassed by a single name; this I have placed without selection, which however another day may demand."

These trivial names Linnaeus often wrote at the bottom of his herbarium sheets, as has been mentioned in the discussion of *Quercus*. In addition, they were placed by him against some of the polynomials in books in his library, thus [Letter no. 816 (Hulth), Dec. 28, 1753]: "I have written in the trivial names in *Flora anglica* Ray, *helvetica* Haller, *monspeliensis* Magnolii, and a lot of others; and thus the species appear short and clear."

In evaluating the trivial name, Link (*Philosophia Novae Prodomus*, 1798, p. 190) says,

"Trivial names are now given to all species, a good invention of Linnaeus by which botany is made brief, easy, and secure. It may be a Latin adjective in apposition with the generic name, but as much as possible it should not be a variable character, i. e., color, or even less a country, which is subjected to political changes, and which a species rarely inhabits solely . . . I would prefer some other substantives added to the generic name, either Greek or barbarous, which could be understood by themselves, and would so explain themselves that their significance would not be a cause of trouble. The *subspecies* should be designated by a third name, preferably by an adjective which denotes in what way it differs

from other subspecies; the *variety* not so, but by a brief phrase; and the *monstrosity* not to be indicated by way of name."

With the exception of the work by Roemer & Schultes, the editions beginning with Murray were unimaginative. Johan Andreas Murray, one of Linnaeus' students, set up rules for the formation of the trivial name similar to those used by Linnaeus for the specific phrase-name. To Linnaeus the trivial name was always an accessory. Murray's changes are to be found in the preface of the thirteenth edition of *Systema Vegetabilia* (1774)<sup>53</sup>. They were published with good intentions but undoubtedly led to greater emphasis of the trivial name. Murray notes (p. x) that he has had to change the "character essentialis" of many species, and because of poor descriptions of recent authors was unable to allocate many species within the genus, but was obliged to place them at the end. In changes of the specific phrase-names (p. xvi) he has added the letter "M", not from any feeling of vanity<sup>54</sup>, but so that any mistakes that were made might not be attributed to Linnaeus. In the edition of 1784 (and also of 1774?) Murray (p. 8) gives Linnaeus' explanation of the origin of genera and species by hybridization:

"Suppose the Creator, in a progression from the simple to the complex and from few to many, at the beginning of plant life to have created as many diverse plants as there are natural orders. These plants the Creator then allowed to reproduce by crossing so that as many plants arose as there are distinct genera today. From these genera, Nature has through generations without change of flowering structures, mingled and multiplied them into existing species. But to be excluded from this type of generation are hybrid plants which are for the most part sterile. Nature therefore confirms that the Genus is natural."

A *Character*, furthermore, does not constitute a genus, but the character is to be carefully drawn up according to the genus as it occurs in nature . . . The *Diagnosis* of a plant consists in the "affinitate *Generis*" and the "discrimine *Speciei*".<sup>55</sup> The name of a plant, "utramque diagnosis indiget", is to be duplex: a) a *Generic cognomen gentilitium*, and b) a *Specific Praenomen*

<sup>53</sup> Murray states (p. ix) that for two years the younger Linnaeus had promised him the editing of the third mantissa of *Species Plantarum*, a work which never appeared due to the illness and early death of Linnaeus, the son.

<sup>54</sup> A similar procedure was followed by Reichard and by Willdenow in their editions of *Species Plantarum*, but no reference was made to vanity.

<sup>55</sup> This statement is somewhat obscure, but certainly different from the Linnaean usage of the term, which applied only to the genus.

*triviale*, and under this the *Synonyma vaga* of authors. And (p. 9):

“The botanist, following the classification, is led by the character of the plant to a named genus; by the differentiae to the name of the species; thence to its synonyms; from these to the authors, and to all the information that has come to us about the object in question through the course of time. Thus the plant tells its name, and its history among a great multitude of species and individuals; this, the first goal of the botanist, has been brought about during our time, and every true botanist should be absorbed in its perfection”.

Miller's seventh edition of the Gardener's Dictionary appeared in 1759. The early editions did not use binomial nomenclature, for Miller, as did Haller,<sup>56</sup> realized the difficulties that would arise from an unrestricted use of the binomials without the concurrent specific phrase name. As Martyn, editing the edition of 1807, says (p. ix):

“[Miller], early and practically versed in the methods of Ray and Tournefort, [was] habituated to the use of these [phrase-names], from his younger years, and it was not without reluctance that he was brought to adopt the system of Linn[a]eus; but he was convinced at length by the arguments of the late Sir William Watson and Mr. Hudson, and embraced it . . . (p. v.)

It is quite evident that Link's observations on the trivial name, especially those dealing with color and geographic locality, were influenced by Murray, who in his edition of *Systema Vegetabilia* (1774) included a supplement with rules for the formation of the trivial name. As he says (Sect. 1): “The trivial name does not render superfluous the definition of a species or the specific differentia; it should however be added whenever in any work there is to be exact determination of plants. Such a necessity exists in the systematic enumeration of plants, in extended designation of either exotic or indigenous species, where there should be some character for comparison, as in medical books or those in plant economy, so that there will not be confusion of species due to lapse of memory or hasty writing”. These rules tended to focus attention on the trivial name rather than the specific name, and

<sup>56</sup> *Stirpium indigenarum Helvetii inchoata historia*. 1768. Introd. p. xxii: “More and more I feel that most genera are artificial, nor can any law be given by which you can determine what discrimination is necessary for separating two genera . . . I have not wished to create trivial names, which Linnaeus and Rivinus have given us, since I realize how meagre several words are, and feel that it would be most difficult to express any characteristic in a single word.”

in that respect perhaps tended to hasten the downfall of the Linnaean method.

#### VARIETIES

As both Lindman and E. L. Greene have pointed out, Linnaeus was the first to distinguish varieties from species, i. e., at the time of Bauhin there was no distinction between species and varieties, all plants being collected under the genus without further formal designation. Thus the statement of Linnaeus to Cronhjelm "botanists pride themselves on having 20,000 species of plants; but there are not more than 8,000 when varieties have been placed under their proper species". A variant of this statement found its way into the preface of *Species Plantarum*: "Numerum plantarum . . . vix 10,000 attingat". (The number of species in the whole world is much less than is generally credited; I have calculated, sufficiently accurately, that there are about 10,000). The actual number of species in the second edition of *Species Plantarum*, was 7540, and these were distributed in 1260 genera.<sup>57</sup> But it should be emphasized here that the Linnaean species was, in general, much more inclusive than that of the modern consensus.

It is generally accepted that the Greek-letter subdivisions in *Species Plantarum* represent varieties, and this view is corroborated by Linnaean correspondence. For example, in Letter no. 542 (ed. Fries) from Bergius, 1769: "Erica Gnaphalodes n. 27. Your synonym which I placed with this species is probably not the proper one, for I see in the new system that E. Gnaphalodes of Sp. Pl. is placed as a variety under *Erica spumosa*." It is obvious that the Linnaean "variety" represented the third and lowest stage in the "Genus, Species, Variety" series, and included all the categories below the species, of our modern literature. The low esteem in which Linnaeus held the too liberal designation of varieties may be gained from a letter to Beck (no. 671, ed. Fries, in 1749): "Rosen's flora has 5 or 6 species; the others are all varieties that no one in these times takes the trouble to look for or describe". This statement, and those in *Philosophia Botanica* (section 306)<sup>58</sup>, was directed primarily toward the dilet-

<sup>57</sup> Sprengel, K. *Geschichte der Botanik*. 2: 284. 1818.

<sup>58</sup> "The use of varieties in economics, cooking, and medicine shows the necessity for their recognition in ordinary life; otherwise varieties should not be recognized by botanists unless care is taken that species are not multiplied or confused thereby

tantes or "Anthophili". The idea that the Linnaean variety as employed in *Species Plantarum* applied only to horticultural variations (*varietates levissimae*), or to plants that we would now call "formae", is quite erroneous. Linnaeus tended toward the reduction of varieties (cf. *Fl. Suecica*, p. ix): "Varieties for the most part I have voluntarily omitted, except for a few which I have placed under their proper species; if, after the manner of some others, I should enumerate varieties in the place of species, I should certainly be able to show more than twice as many plants; I have however judged that the plants themselves and not their mere increase should be considered and I have departed from that custom". That the Greek-letter subdivisions of *Species Plantarum* often have a geographical significance is evident from such examples in *Species Plantarum* as:

*Juncus pilosus* (p. 329). Habitat in Europae sylvis, at varietates  $\beta$ ,  $\delta$ ,  $\epsilon$  in Europae australioribus;  $\gamma$  in Alpibus.

*Bupleurum angulosum* (p. 236). Habitat in Pyreneis.  $\beta$  in Vallesiae alpibus.

*Asarum canadense* (p. 442). An varietas praecedentis (*A. europaeum*); sic suadet Folia bina, dissuadet alia.

In *Flora Suecica* a similar treatment of varieties based on habitats had been carried out for *Myosotis* (no. 149) and *Gentiana* (no. 203). And in the *Amoenitates Academicae* 1: 334. 1743, the paper on *Betula nana* treats the Greek-letter variants as having a significance quite remote from that of cultivated plants. It should be kept in mind, however, that one of the chief functions of *Species Plantarum* was to dispose of the loose-lying varieties of Bauhin's *Pinax*, and to place them under their proper species; hence the large number of Greek-letter subdivisions under such important cultivated plants as *Prunus Cerasus*, *Prunus domestica*, and various species of *Pyrus*.

The following observations in sections of *Philosophia Botanica* provide a good background for the problem of *varieties*:

158. Varieties are as many as there are different plants produced from the seed of the same species. This is due to accidental causes: climate, soil, temperature, winds, etc. Varieties often revert when the soil is changed.

259. That varieties are distinct species, no sane person admits in the animal kingdom: for there are white cows, black cows, lean and fat cows,

---

Obvious varieties, in general use, are inserted at the end of the differentiae when necessary."



smooth and wooly cows, and no one has thought that the most diverse represent species.

317. It is as important to assemble varieties under their species, as it is to place species under their genera. The constancy of the older botanists in treating species as distinct, was superseded by the eagerness of more recent botanists (previous to the end of the last century) in augmenting the number of plants and infecting the science by the introduction of varieties as species. This heresy was first opposed by Vaillant, then by Jussieu, Haller, Royen, Gronovius, and a few others, in order that botanical science might not be ruined.

Many varieties can be easily traced back and explained by comparing their variable characters with those of the natural plant; but there are not a few varieties which demand both genius and experiment. The botanist who chooses to occupy himself with varieties can hardly reach his goal—the bounds of interplay of polymorphic nature.

310. *Varietates levissimas non curat Botanicus.* The horticulturists (Anthophili), unremitting in their industry and observation, see in the corollas of flowers marvellous things which the untrained eye cannot perceive; their object is the most beautiful flowers of Tulips, Hyacinths, Dianthus, Primulas, etc. To obscure varieties of these they give names that arouse wonder! They cultivate the science of flowers, all its own and pertaining only to themselves. Into their camp no sane botanist goes.

The technical aspect of varieties, from the modern point of view, has been so extensively discussed in recent literature<sup>59</sup> that little space is needed here. As I have pointed out in a discussion of *Hypericum cistoides*, many of our present varieties have no geographic background, and represent merely random variations in herbarium collections. Moreover we are not certain that some of the variations that we call “geographic” are not responses to climate and soil. The history of subspecies of the ornithologists is quite different from that of the botanists.

#### THE HERBARIUM

The status of some specimens in the Linnaean Herbarium, especially of the genus *Quercus*, has been discussed. The best general statement on the Linnaean Herbarium seems to be that of C. B. Clarke, the eminent specialist on the *Cyperaceae*, in *Journ. Linn. Soc. Bot.* **30**: 299. 1894:

“The herbarium of Linnaeus appears to have originally contained a perfect, or very nearly perfect, set of examples (one, two, or rarely more, sheets of each species) representing the *Sp. Pl.* ed. 1. Each sheet of this set was numbered and named in the hand of Linnaeus, in ink, on the paper

<sup>59</sup> Cf. R. T. Clausen in *RHODORA* **43**: 157–167. 1941; and C. A. Weatherby in *RHODORA* **44**: 157–167. 1942. The problem of varieties is also discussed in the outstanding paper by Ramsbottom, *Proc. Linn. Soc. London*, 150th Session: 192–219. 1938.

itself, the numbers corresponding always to the species-numbers in the *first* edition of the Sp. Pl.

“The herbarium of Linnaeus has been, as is well known, disarranged: a quantity of additional material has been mixed into it; some of the original names have been crossed out; some of the original sheets have been moved, and many have disappeared altogether. There still remain, however, in the Cyperaceae enough of these authentically named sheets to verify more than half the species described in his Sp. Pl. From comparing these so many times, I have come to the conclusion that we possess, in them, in every case, a specimen plant that Linnaeus himself referred to the name he wrote on them. Besides these (usually numbered) specimens there are a good many other sheets named in Linnaeus’s hand (but without numbers) which refer to species subsequently published under Linnaeus’s names in the Sp. Pl. ed. ii, in the Mantissa, and in Linn. f. Suppl.”

And Ramsbottom (Linn. Soc. London Proc. 148th session, p. 26. 1936), in discussing Savage’s paper on Burser’s herbarium:

“When dealing with the Linnaean Herbarium some botanists seem to have lost their sense of proportion. Great as Linnaeus’s opinion of his own work was—with abundant reason—it is foolish to imagine that he could ever have anticipated the importance that future botanists would place on his specimens. Consequently his herbarium was likely to contain some specimens which had been placed with less care than had the majority; moreover, it took many years to accumulate.

“It was common knowledge that all the specimens contained in the Linnaean Herbarium were not types and that all his types were not in his own herbarium; some, for example, were in the Department of Botany [British Museum] in the Hortus Cliffortianus and the Sloane Collections.”

Linnaeus notes in the introduction to *Species Plantarum* that Clifford gave him all the specimens that he had in duplicate, and that Gronovius gave him many Virginia plants. In the several volumes of Linnaean letters published by Hulth are references here and there to the herbarium, and of these I quote a few:

No. 767 (to Beck) Jan. 28, 1753: “Take out as many duplicates as you are certain of; then there will be room in the herbarium”. No. 61, vol. 2 (to Aymen) May 14, 1753: “You say that you have 6000 *plantas exsiccatas*; I have received plants from nearly the whole world, but have obtained only 6000”. No. 1172 (to Celsius) Nov. 1736 (written from Hartekamp, Holland): “Sloane’s big collection is wholly in disorder. I got a lot of rare species in England, especially of American plants, such as Sassafras, Canella alba, Alpinia, Barleria, Bauhinia [no.] 6, Bellonia, Bocconia, Breynia, Brunfelsia, Cameraria, Coa, Cornutia, Dioscorea, Dodonea (mea, non Plumieri), Fuchsia, Hermania (formosissima arbuscula), Jan roja (?), Karatas, Magnoliae 2nd. spec., Mancinella (venenatiss.), Maranta, Petivera, Millera Houst., Kaempferia Nobis, Collinsonia nob., Mollugo nob., Dorstenia Plum., Catesbaea Gronov., Ammania Houst., Triopteris nob., Tetracera nob., Lippia Houst., Dalea Nob., Trigonella nob., Guazuma Plum. &c. Nearly all of them I brought back living to Holland

. . . . I am now working hard on Hortus Cliffortianus, which is now up to 300 quarto pages; altogether it will go well over a thousand." Fries has provided the following footnote: "In 1736 Linnaeus visited England, returning to Clifford in Holland in 1737, when he assisted Gronovius on the Flora Virginica. In October he left for Sweden and remained there until the end of February, 1738. He then went to Hartekamp in Holland, which he left in May, 1738; next he went to Paris, and then to Sweden, where he was married in June, 1739."

The "herbarium parvum" was obtained by Alstroemer, who supplied the younger Linnaeus with travel funds. It was composed of specimens from the large herbarium, left at Alstroemer's place in Halland, and eventually came to the museum at Stockholm. (cf. Fries: Biographical Sketch of Alstroemer in Letters, Vol. 1, pt. 3. p. 13. 1909).

No. 968 (to Beck) Feb. 22, 1758: "I have sent 600 thalers to London for Browne's herbarium; I hope it comes intact through the pirates. It certainly must have Rolander's plants". No. 976 (to Beck) July 18, 1758: "Finally I have received Dr. Browne's Jamaica herbarium, which I have been waiting for so long; it contains more than 1000 beautiful plants . . . Here I find all the rare plants which I saw hastily at Rolander's and all that Loeffling has described".

No. 440 (to Elvius) Dec. 1773: "I have read through Retzius' paper in which he wants to make 4 species of out *Sophora biflora*. Of this large tree, called *coral-tree*, I have several specimens. As I read through the paper much seemed paradoxical. But I did not wish to trust to my memory, until I came to the country to my collection, which in all ways confirmed my previous ideas . . . The peduncles are usually *biflori*; in poor soil they become *uniflori* . . . and I have specimens which have peduncles *unifloris et biflores* on the same branch . . . So I see in this paper nothing which is to be gained, but only more harm, and the placing of 4 species *incorrectly* for one which is certain."

An extensive list of papers dealing with the Linnaean Herbarium will be found in Soulsby's "Catalogue of the Works of Linnaeus" published by the British Museum, 1933, pp. 217-222.

### THE NATURAL SYSTEM

The idea of a natural system interested Linnaeus at an early date.<sup>60</sup> As mentioned in *Philosophia Botanica* (1751, p. 25) a

<sup>60</sup> Spring, p. 5: "The regular arrangement of natural objects under the lowest element of unity [i. e., species] gives us what Linnaeus, for example, called a 'natural system'. But the subjective natural system, as it is set up in the sciences, is quite different from the actual or objective; the latter is an ideal which the former, as much as possible, strives to illustrate."

Spring, p. 6: "The natural system has a double role to fulfill

1) It serves as a register in which each discovered natural object is arranged without constraint, and where each object already named and determined can be placed without difficulty.

natural method had been sought by Royen, by Haller, and by Wachendorff, according to cotyledons, calyces, etc. The "Fragmenta" of a natural system (p. 27-36) were composed of 67 groups, together with an additional group of plants which were of vague or uncertain status. "This is the first and ultimate desideratum in botany. *Natura non facit saltus*.<sup>61</sup> All plants show an affinity on either side, as a territory in a geographic map. The lack of undetected plants has been the cause of deficiency in the natural system, rather than that the knowledge of many plants has perfected it; for *Natura non facit saltus*."<sup>62</sup>

Schuster, *Nachwort über das Natürliche System*. p. civ. 1926, briefly reviews the situation.

"In *Classes Plantarum* (1738) Linnaeus says that he has worked for a long time on the natural method . . . that he could not complete it within his lifetime . . . and that the key to the system could be given only when all plants had been brought under their natural orders. The natural system must be improved, rebuilt, and completed; those who do so will be the reigning botanists. The principles would be that here no *a priori* rule would suffice, no definite part of the fructification organs, but the integral relationship of all parts". (Schuster notes here that Linnaeus has already seen the principle of the Organism as a Whole). "The relationship of the artificial system Linnaeus explained as follows: the system is for the purpose of determining plants without an instructor. Without a key there is no method for the natural families. But since a key to the natural families is nearly or quite impossible, one can use only the artificial system for identification; the artificial system deals only with the diagnosis of plants, the natural only with the internal character or nature of plants. Who therefore refers to the artificial system resembles a builder who cannot complete the roof of the house. In the last analysis

---

2) It should provide us a picture of the plan of Nature, of natural objects in their natural relationships.

The first is the function of the so-called artificial system; the second of the natural system. Completion of the natural system is the most important contribution to Natural History. The better it is done, the more unnecessary an artificial system will become in time."

<sup>61</sup> This phrase had also been used by Ray, *Hist. Plant.* sig. A<sub>3</sub> verso. "Nam, cum *Natura* (ut dici solet) *non faciat saltus*, neque ab extremo ad extremum transeat nisi per medium . . . (for, *Nature*, as we say, does not make a leap and does not proceed from one extreme to the other, except through intermediaries) . . .

<sup>62</sup> Cf. A. P. DeCandolle, *Théorie Élément. Bot.* 1813, p. 45. "Several objections have been made to the system based on a separation contrary to the natural order; but since Linnaeus is the first to have distinguished the natural from an artificial system, he is far from meriting such a reproach. Also whoever examines the [artificial] system sees how relatively certain it is for discovering the names of plants." And p. 59, "The group of imitators of Linnaeus have poorly understood the master and have attributed opinions to him contrary to those he actually held. It is today truly remarkable that those who call themselves Linnaeans are in direct opposition to all the pages of Linnaeus, while Linnaeus and Jussieu were practically in accord on all the principles of the science. Linnaeus was always in favor of the natural system."

Linnaeus' wisdom is a compromise between the unattainable natural and the completed artificial system".

The manuscripts of Linnaeus' student, Fabricius, were issued and edited in 1926 by Schuster [see introductory paragraph of this paper]. In discussing the "chain of nature", Fabricius says:

"Our illustrious preceptor knew how commonly, though erroneously these words were often used, for he was among the first to contend that the affinities of natural objects are many, according to the various relationships observed. Well known is his statement in *Phil. Bot.* 77: 'Plantae omnes utrinque monstrant, uti Territorium in Mappa geographica'. Should the word 'catena' be employed, it will not be found to be a simple chain, but multiplex and intertwined, and with many free ends which are not connected with other links. On the other hand, the word 'scala' is quite inept. What use I ask, is a ladder, if certain steps are missing, sometimes so many that you cannot make the jump to the succeeding ones? or if after a few steps there may be a huge hiatus to be ascended? Certainly I would not wish to use such a ladder. More apt is the idea of a reticulum (*retis*) of which the substance is disrupted here and there at random. Or to speak without metaphor: into continuous families many plants are joined, each of which has the lineaments of the family, but is otherwise distinguished from the other, as men of the same family in face, stature and approach. Those which are more similar are placed closer to one another, as tribes are joined from families . . . . But there are families, in plants as in humans, in which the connection can be seen only as a probability or not at all. Here the network is broken; there it is continuous. The most apt comparison is with a geographic map, where the families of the first group form provinces in their own right, the middle group (which constitute most of the reticulum) form boundaries with these, and those which do not directly cohere form islands. Upon this idea the table has been constructed". [Cf. the appended chart from Giseke's "Praellectiones"]<sup>63</sup>.

"Thus, let it be supposed that the mystery of creation was being investigated, and a method imitating nature could be found. Who then seeks the natural method 1) forms *genera*, and these *natural*; 2) having formed these, he examines their convergences and affinities, and then will come the idea of order. For no one will say that *Zea* and *Poa*, for example, are of the same genus, though he sees that they are related. He therefore concludes that they are diverse genera of the same order.

"If this method is really natural, the affinities of genera and orders should appear among themselves; thus the natural method should be set up so that the genus or order should be intermediate to the preceding or following genus or order with which it coheres; in this way the chain arises. But such a method cannot be easily shown; for genera are lacking which

<sup>63</sup> Cf. Sprengel, K., *Geschichte der Botanik* 2: 242. 1818: "Finally Linnaeus appears to have occupied himself studiously with the Natural Method. At least this is shown by his 'Vorlesungen' on the natural families, which he held at his country place, Hammarby, until 1771. (Praellectiones in Ordines Naturales, ed. Giseke, Hamburg 1792)."

See also Sprengel's editions (1809) of *Philosophia Botanica*, Sect. 77: "Fragmenta, quae Linnaeus proposuit, in Praelectionibus a Gisekio editis, haec sunt".

have not yet been detected, which cause a hiatus and a defect in the natural chain, so that order at times may seem to be lacking. Hence anomalies arise, which have an uncertain place in the natural system. But the natural method, though best, cannot be easily discovered; therefore the artificial is to be sought, so that genera can without difficulty be located and distinguished".

The accompanying chart (PL. 991) of the Linnaean natural orders has an ingenuity equal to the phylogenetic charts of the present day, though it bears the inscription, "Tabula genealogico-geographica Affinitatum Plantarum secundum Ordines Naturales Linnaei delinavit Paulus Dietericus Giseke, 1789". The explanation is given on p. 623 of Giseke's "Praelectiones", of which fragments (in translated form) are included here:

"There are provinces (of circles) of which some are merely neighbors while others are contiguous, which I have tried to indicate as clearly as possible. When circles are closely assembled they usually, but not always, indicate neighboring provinces. Thus the first 13 orders are not only as Monocotyledons more closely related to one another than to others, but furthermore even by genera themselves, which are inscribed at the periphery. One of these, the *Palmae*, is related to the Acotyledons; another, the *Filices*, through *Equisetum*, is related to the *Amentaceae* and *Coniferae*. Thus they are not only neighboring but contiguous. The *Hesperideae* and *Preciae* [*Primula*, etc.] are closely related, but there is no intermediate genus by which they can really be joined. The *Aggregatae*, with seeds solitary and naked, approach the *Compositae*. . . . From the *Compositae* recedes the order of *Umbellatae*, with two naked seeds, but only in degree does it differ in inflorescence (cf. *Eryngium*) . . . . Finally, from the *Compositae* the *Columniferae* are not so greatly removed, in the character of the solitary seeds . . . . This is the plan of affinity, or GENEALOGY.

"As to the GEOGRAPHIC nexus, the provinces of the Monocotyledons (I-XIII) are sufficiently close. But others are much more distant than can be expressed in the plate. From the *Personatae* to the *Tricoccae* the distance is greater than the map shows. The former probably touch the *Luridae* from which the *Campanaceae* are removed, for there is similarity in the corolla of certain plants (e. g. *Datura* and *Convolvulus*), the number of stamens and pistils, and the similar fruit. With some others, *Campanula lactescens* might seem to make a transition to the *Contortae*. Though many *Tricoccae* have milky juice, none can be combined [with the *Campanaceae*] by means of the fruit. For Linnaeus did not wish to build orders on qualities. Thus there are islands . . . . but none of the islands is more remote from other provinces or other islands than the *Siliquosae*. . . .

"Finally, as to the amplitude these provinces of islands attain, I have taken the proportion that the number of genera in any order should be a third of the radius of the circle (at the time the map was drawn in 1789, not as in the exposition of orders, in which many new genera from the recent *Genera Plantarum* Linn., ed. Schreber, were added) . . . . Thus in the *Stellatae* there are 25 genera, a third of which is 8; therefore the

radius [one-half the diameter] should be four lines long. But if this is carried out in the smaller orders (as those of 10 or 7 genera) the names could not be written in or read, and the radius has been made larger. Such are inscribed with an asterisk. If made on the same scale, the *Compositae* would have taken the whole page, so the proportions are there reduced.

“. . . Order XVI is not in the table, because the genera are so few . . . Nor are there any in LIV, of which I did not at all understand the inscription *Miscellanea* until I heard Linnaeus . . . Thus he explained to me: ‘Whoever has seen *Sarracenia* in flower does not question its close affinity with *Nymphaea*, but at what place can both be put?’ I responded that I would associate it with *Papaver*, on account of the similarity of the stigma of *Nymphaea*. He replied that he would concede that point, but that plants were lacking which would properly join with the rest of the parts”.

The transitional genera between orders are written in fine script on the plate. The orders on the plate, together with the number of genera in each order, the connecting genera and the orders which they connect, are enumerated below:

- |  |                              |
|--|------------------------------|
| I. Palmae 10                           | XIII. Succulentae 29         |
| Nipa—Filices                           | Sedum                        |
| Hydrocharis—Tripetaloideae             | XIV. Gruinales 14            |
| II. Piperitae 10                       | Linum—Caryophylleae          |
| Acorus—Tripetaloideae                  | XV. Inundatae 10             |
| III. Calamariae 12                     | XVI. Lacking (see note)      |
| Carex—Gramineae                        | XVII. Calycanthaceae 17      |
| Scirpus & Schoenus—Tripetaloi-<br>deae | Rhexia—Bicornes              |
| IV. Graminae 54                        | XVIII. Bicornes 23           |
| Cenchrus & Cynosurus—Calama-<br>riae   | Kalmia—Calycanthemae         |
| V. Tripetaloideae 8                    | XIX. Hesperideae 19          |
| Butomus—Palmae                         | XX. Rotaceae 14              |
| Sagittaria—Ensatae                     | XXI. Preceae 12              |
| Juncus—Calamaria                       | XXII. Caryophylleae 31       |
| VI. Ensatae 10                         | Lychnis—Gruinales            |
| Ixia—Tripetaloideae                    | XXIII. Trihalatae 13         |
| Crocus—Spathaceae                      | XXIV. Corydales 10           |
| Gladiolus—Orchideae                    | Fumaria—Rhoeadeae            |
| Iris—Coronariae                        | XXV. Putamineae 8            |
| VII. Orchideae 11                      | Capparis—Rhoeadeae           |
| Serapis—Ensatae                        | XXVI. Multisiliquae 24       |
| VIII. Scitamineae 13                   | Trollius—Rhoeadeae           |
| IX. Spathaceae 12                      | XXVII. Rhoeadeae 6           |
| Colchicum—Ensatae                      | Chelidonium—Corydales        |
| Erythronium—Coronariae                 | Sanguinaria—Fumarineae       |
| X. Coronariae 20                       | Podophyllum—Multisiliquae    |
| Lilium & Martagon—Ensatae              | XXVIII. Luridae 19           |
| Tulipa—Spathaceae                      | Pedalium & Datura—Personatae |
| Amaryllis—Sarmentaceae                 | XXIX. Campanaceae 15         |
| XI. Sarmentaceae 21                    | Lobelia—Contortae            |
| Alstroemeria—Coronariae                | XXX. Contortae 25            |
| XII. Oleraceae 36                      | XXXI. Asperulae 10           |
|  | XXXII. Papilionaceae 55      |
|  | XXXIII. Lomentaceae 10       |

XXXIV. Cucurbitaceae 12	Capitatae
XXXV. Senticosae 12	Sphaeranthus & Echinops—Aggregatae
XXXVI. Pomaceae 10	L. Amentaceae 14
XXXVII. Columniferae 43	Casuarina—Filices
XXXVIII. Tricoccae 35	Betula—Coniferae
XXXIX. Siliquosae 31	LI. Coniferae 7
XL. Personatae 63	Cupressus—Amentaceae
Martynia & Barleria—Luridae	LII. Coadunatae 8
XLI. Asperifoliae 21	LIII. Scabridae 12
XLII. Verticillatae 39	LIV. Miscellaneae
XLIII. Dumosae 19	LV. Filices 18
XLIV. Sepiariae 9	Zamia & Cycas—Palmae
XLV. Umbellatae 50	Osmunda regalis—Musci
Sium & Ninsi—Hederaceae	LVI. Musci 10
XLVI. Hederaceae 7	Lycopodium clavatum—Filices
Panax—Umbelliferae	Hypnum—Algae
XLVII. Stellatae 25	LVII. Algae 12
Phyllis—Umbelliferae	Jungermannia—Muscae
XLVIII. Aggregatae 30	Marchantia & Tremella—Fungi
Dipsacus & Globularia—Compositae	LVIII. Fungi 11
XLIX. Compositae 120	Agaricus & Peziza—Algae

With this brief account of the Natural Method of Linnaeus, it may be of interest in the nature of a review to insert here what were the last words of Linnaeus on botanical method—the preface to the Second Mantissa, dated September 1, 1771.

“In the twilight of my life I am assembling some scattered accounts and unrecorded observations to add to the First Mantissa. I have emended some *differentia specifica*, where I have seen better or living specimens . . . Dubious synonyms, formerly admitted, I have often excluded here; for not in many synonyms, but in true specific differentiations lies the strength of the art. The new species of many authors I would gladly have inserted, if the essential characters had been included, but with these lacking I was obliged to omit plants which I had not seen myself. Some botanists talk loudly about the *Natural Orders* in place of a method, but so long as there is no essential character of an order, by which the genera can be combined or distinguished from those of different orders, these orders remain as a bell without a clapper. However, their use in other respects may be of the greatest importance.

“If anyone after my time should publish my *Systema*, *Genera*, or *Species*, I beg him to insert in its proper place, each of the plants that I have noted in the Mantissae, Systema, and the various appendices. If he should wish descriptions of species he will find them in *Hortus Cliffortianus* and *Hortus Upsaliensis*, in *Flora Suecica* and *Flora Zeylanica*, in the *Amoenitates* and in my *Travels*”.

#### RESUMÉ

Not until Redi had disposed of the doctrine of spontaneous generation, and Harvey had shown the continuity of life from the egg, was it possible to place species on a firm basis, i. e., immutability, and to observe that “there are as many species as were



created in the beginning". The doctrine of immutability of species from the beginning was to give way later in Linnaeus' life to the idea that existing genera and species had been derived by the crossing or hybridization of a few created forms. As early as 1733, Linnaeus had outlines of his chief botanical works: *Bibliographia Botanica*, *Philosophia Botanica*, *Genera Plantarum* and *Species Plantarum*. The last-named work (1753), the basis of modern nomenclature, may be looked upon as a revision of Bauhin's "Pinax" in which the unit of classification was to be the *species*; whereas in Bauhin's work the *genus* was the unit of classification. Binomial nomenclature, as used in *Species Plantarum*, consisted of the *genus* and a *trivial* name, the binomial to be used as a supplement to (but not a replacement of) the polynomial specific name. Treatment of the genus (*Genera Plantarum*) was in three stages of amplification: 1) the *natural character*, essentially a description; 2) the *factitious character*, a few notae sufficient to distinguish genera in an artificial order; and 3) the *essential character*, a single unusual character sufficient for recognition. The goal, as in modern times, was to find the *character essentialis*. At the time of publication of "Species Plantarum", both genera and species were considered by Linnaeus to be "natural"; i. e., they were created units, and it was the duty of man to group together those species which belonged to a genus. According to Linnaeus: "*All genera and species are natural: unless this principle is assumed there can be no soundness in the art*". This point of view was strongly opposed by Lamarck who considered all genera as artificial.

As Spring and others have pointed out, most of our genera are not natural units; but merely represent a stage of classification above that of the species. Nor did the doctrine of descent with modifications of Lamarck and of Darwin ease the Genus problem, since it introduced the additional element of time into a system which had been preeminently concerned with the nomenclature of plants and animals as they are distributed in space. To this problem of the Genus, Linnaeus seems to have given a good answer: "The limits of a genus cannot be determined until all the species of the genus are known". In the author's opinion, the attempt to make all genera "natural", without some conventional limitations, would be destructive to nomenclature, which is built up primarily on a basis of history and usage.

“The Ariadnean thread of the systematists terminated in Genera, but I have attempted to extend it so far as Species, for which I have made proper differentiae”. As in the treatment of the Genus, there was also a threefold aspect of technical delimitation: 1) The *Descriptio*, or *character naturalis*; 2) the *Nomen Specificum*, or polynomial phrase-name, based on differentiae taken from the *Descriptio*; 3) *Nomen specificum essentiale*, in which only a single character (*nota*) was present, and which constituted the goal of differentiation in species; but most Linnaean specific names remained in the *synoptic* stage, where several characters (*notae*) were still required for differentiation. The trivial name was placed “in the margin” in *Species Plantarum*.

The polynomial phrase name (specific name) required changes when it was converted from a synoptic to an essential name; also changes were usually necessary in adjacent specific names when a new species was introduced into the genus, in order to balance the differentiae; new specific names were required when pre-Linnaean and other specific names without differentiae were introduced into the Linnaean system. These older specific names became synonyms.

The Linnaean species appears to have been an aggregate of the synonyms, illustrations, herbarium specimens and living plants noted in the gardens at Upsala and elsewhere. All synonyms seem to have been of equal value, since “by any synonym you can know the species”. The Linnaean species, therefore, included all material encompassed by the specific name. Distinctions were not so closely drawn as at the present day, and in general each Linnaean species consisted of several species, as delimited by modern consensus. Illustrations played a large part in Linnaean procedure. Specimens were placed in the herbarium as representative of the species, but were frequently discarded or replaced. Selection of a representative element for each Linnaean species, would seem largely dependent on usage.

The Linnaean natural system as it was conveyed to his student, Gieseke, is shown in graphic form, with explanations.

The writer is greatly indebted to Mr. C. A. Weatherby for a number of suggestions made after reading the manuscript, and to Mr. W. L. Dix for his help in translating the Latin of the preface of Roemer & Schultes' *Systema*.

BROOKLYN BOTANIC GARDEN